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Vermicompost and Its Role in Growth of *Lycopersicum esculentum* Mill. (Tomato Plant)

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ABSTRACT

Excessive and indiscriminate use of chemical fertilizers and pesticides not only causes environmental degradation but also deterioration of soil health, which results in decline in crop productivity. Besides, it has health consequences for the human beings. Hence, organic source of plant nutrition is gaining momentum in the last few decades. The use of vermicompost in organic farming is gaining prominence these days as it helps in attaining higher productivity without causing any harm to the environment. In the present work, we have used different raw materials for the preparation of vermicompost such as cow dung, vegetable waste, corrugated cardboard and straw. The vermicompost so prepared was applied on tomato plant (*Lycopersicum esculentum* Mill.). The treated tomato plant was found to record healthier growth (with higher yield) as compared to control plant.

Key Words - Vermicompost, organic farming, tomato, t-test, Environment.

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INTRODUCTION

Vermicomposting is the process of using worms to convert organic waste materials into a humus-like material known as vermicompost. The vermi composts are environment-friendly and help in achieving higher yield in the treated plants. On account of adverse side-effects of the use of chemical fertilizers in farming as it damages the soil and poses health risk for the human body, organic farming and products are becoming popular. Vermicompost aid in organic farming and promote sustainable development. (Alidadi, H. *et al.*, 2007)

In the present study, vermicompost was prepared and applied on tomato plant (*Lycopersicum esculentum* Mill.). Study was made using both control and treated samples. Findings suggest favourable use of vermicompost in achieving health growth of plants and higher yield of fruits.

MATERIALS AND METHODS

Basic Raw Material

Vermicompost can be prepared using any type of biodegradable wastes. As such vegetable waste, crop residues, leaf-litter, weed biomass, waste from agro-industries and biodegradable portion of household wastes can be used as basic raw materials for vermicomposting. The quality of Vermicomposting can be improved using a mixture of leguminous and non-leguminous crop residues (Amlinger, F. *et al.,* 2003). We had used different biodegradable raw materials for the preparation of Vermicompost such as cow dung, vegetable waste, corrugated cardboard and straw (Table1).

Table 1: Raw Materials Used in Preparation of Vermipit

Sl. No.	Material	Benefits
1	Cow Dung	Possesses very high nutritional value for plants. Very high nitrogen content.
2	Vegetable Waste	High N-content, besides important vitamins and minerals.
3	Corrugated Cardboard	Contains high protein. Worms like this material.
4	Straw	Higher nutrition contents for plants; good moisture content. It helps in maintaining humidity.

Fig. 1

Fig. 2

Fig. 3

Figures 1 to 3: Preparation of Vermicompost

Vermicomposting is done by various methods (Atiyeh, R. M. *et al.*, 2000, Atiyeh, R. M. *et al.*, 2002, Bayon, L. R. C. *et al.*, 2006, Elvira, C. *et al.*, 1998, Ndegwa, P. M. *et al.*, 2006, Tohidinejad, A. *et al.*, 2011, Parvaresh, A. *et al.*, 2005). Amongst them, bed and pit method is more common. We are using pit method in a small plastic plant pot.

Step-wise procedure of Pit method:

The pit was prepared with the following dimension: 20.3 cms height, 18 cm upper width, 20 cms lower width. The following steps were followed in the preparation of the pit:

a) Layering: The pit was filled with three layers of different materials. First layer made the bedding material (one inch) with soft leaves. Second layer (9 inch thick) stood above the first layer and consisted of organic residue (fine chaffed material). Third layer formed the top layer, which was filled with a mixture of dried cattle dung and water (mixed in equal amount).

b) Introduction of worms: On the 7th day, about 350-360 worms were introduced into the pit, without disturbing it.

c) Maintenance of adequate moisture and temperature: Proper moisture and temperature is maintained by frequent watering, turnings and subsequent staking.

d) Watering: The filled materials are watered and turned at regular interval.

We are using plastic pot as in pit method for the preparation of Vermicomposting (Figures 4 and 5). The turnover of the compost is 75% implying that if the total material accommodated in the pit is 1000 kgs; the out turn will be 750 kgs.

Fig. 4

Fig. 5

Figures 4 & 5: Plastic pots for Vermicomposting

The vermicompost material was prepared in the University Department of Botany PGDMP laboratory, Ranchi University.

RECOMPOSTING AND *IN-SITU* VERMICOMPOSTING

Recomposting is done in the same pit or bed following the same steps described as above. Five phases of vermicomposting include: collection of waste materials, pre-digestion, earthworm bed preparation and composting, harvesting of Vermicomposts and Earthworms, and packaging and storing of vermicomposts (Figure 6).

Phase I: Collection of waste materials

▼

Phase II: Pre-digestion

▼

Phase III: Earthworm bed preparation and composting

▼

Phase IV: Harvesting of Vermicomposts and Earthworms

▼

Phase V: Packing and storing of Vermicomposts

Figure 6: Five phases of vermicomposting

COLLECTION OF MATERIALS

Selection of Suitable Earthworm:

For vermicomposting, surface dwelling earthworms are used (Atiyeh, R. M. *et al.* 2000). In the present investigation, we have used *Eisenia foetida* (Hartenstein, R. *et al.* 1981). (Figure 7). It was collected from Anusandhan Sah Pradarsh Prasaar Kendra Gadhkhatanga Ranchi Jharkhand.

Figure 7. *Eisenia foetida* earthworm

Feeding material: Cow Dung, Biogas Slurry, or Cattle Urine

At the beginning of the process of composting, cow dung can be used as feeding material in order to breed sufficient numbers of earthworms (Khalfi, M., *et al.* 2005). On attaining desired number of worm population, subsequently other sources of organic wastes can be provided to maintain the population of earthworms (Ndegwa, P. M. *et al.* 2000). The cow dung was collected from a milkman in Morabadi.

Containers For Vermicomposting Production

A Plastic pot of the said dimension was used as a container for vermicompost production. The bottom of the tub was punctured and a hole was made to drain the excess water from Vermicomposting unit. A glass chamber was provided to protect it from the predator like rat and ant, which might damage the compost.

Sowing of seeds: Seeds of tomato plant had been grown in coco peat. Coco peat absorbs more water and helps in rapid germination (L. J. Chanu *et al.* 2018). (Figure 8 to 10)

Fig. 8

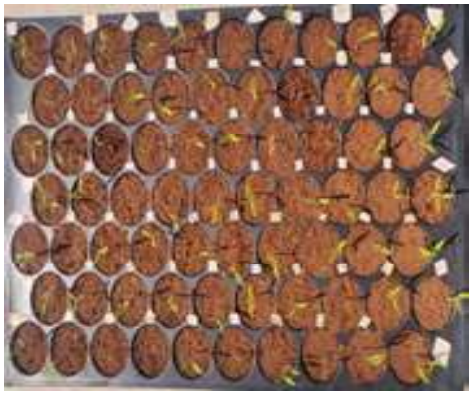

Fig. 9

Fig. 10

Figures 8 to 10: Sowing of seeds in coco pit

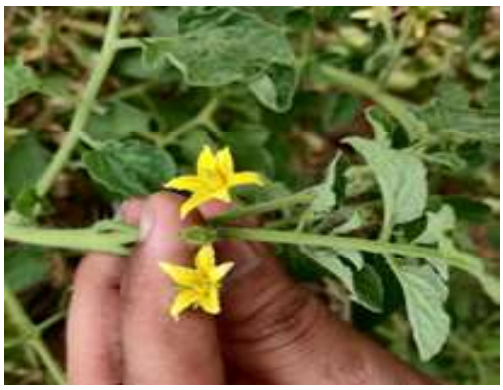

Fig. 13

Figures 11 to 13: Tomato Plant Growth without Vermicompost

RESULT

Vermicompost enhances the growth of nitrogen-fixing microorganisms in the soil. Enhanced nitrogen availability through the intimate mixing of ingested particles improves the soil productivity resulting in improved crop growth and increased fruit yields. We did find increased microbial biomass rich in carbon and nitrogen in the Vermicompost. Thus, a high nutrient or hormones status of soil with vermicompost may improve the speed of tomato growth. The effect of vermicompost on tomato plant is faster growth as leaves appear rapidly (Hoekstra, N. J. *et al.* 2005). After application of Vermicompost, fruits also grew faster in the case of treated plants (Figures 11 to 16).

Fig. 11

Fig. 12

Fig. 14

Fig. 15

Fig. 16

Figures 14 to 16: Tomato Plant Growth with Vermicompost

Mean growth of vermicompost treated plant samples showed higher growth than the control tomato plant samples (Table 2). This suggests that vermicompost helps in achieving higher yield.

Table 2: Descriptive Statistics of Growth of Control and Treated *Lycopersicum esculentum* Plant

	Control Plant			Treated Plant		
Day	**Mean**	**Std. Dev**	**Std. Error**	**Mean**	**Std. Dev**	**Std. Error**
Day 10	2.99	0.59	0.19	5.44	1.15	0.36
Day 20	17.76	2.20	0.70	14.69	2.09	0.66
Day 30	25.49	2.82	0.89	25.03	3.18	1.01
Day 40	36.57	4.88	1.54	43.40	6.60	2.09
Day 50	43.29	4.99	1.58	60.73	4.18	1.32
Day 60	49.49	4.18	1.32	72.57	3.32	1.05
Day 70	56.20	4.29	1.36	80.32	3.89	1.23
Note: Calculations based on 10 samples.						

Paired t-test analysis was undertaken to understand if there has been any significant difference between the growth of control and treatment (treated with vemicompost) samples. The null hypothesis of no significant difference between the growth in control and treatment samples was found to be rejected (Table 3). The results suggest that vermicompost can help improve the yield of tomato plants.

Table 3: t-Test (Paired)

Plants	Null Hypothesis	t-statistics	p-value	Decision
Sample 1	No significant difference between the growth in control and treatment	-4.016	0.003***	Reject Ho
Sample 2	No significant difference between the growth in control and treatment	-2.451	0.025**	Reject Ho
Sample 3	No significant difference between the growth in control and treatment	-1.623	0.078*	Reject Ho
Sample 4	No significant difference between the growth in control and treatment	-2.689	0.018**	Reject Ho
Sample 5	No significant difference between the growth in control and treatment	-2.843	0.015**	Reject Ho
Sample 6	No significant difference between the growth in control and treatment	-1.866	0.061*	Reject Ho
Sample 7	No significant difference between the growth in control and treatment	-2.002	0.051*	Reject Ho
Sample 8	No significant difference between the growth in control and treatment	-2.100	0.045**	Reject Ho
Sample 9	No significant difference between the growth in control and treatment	-1.903	0.058*	Reject Ho
Sample 10	No significant difference between the growth in control and treatment	-2.227	0.038**	Reject Ho
All samples	No significant difference between the growth in control and treatment	-2.335	0.033**	Reject Ho
Note: *: 10% level of significance; **: 5% level of significance; ***: 1% level of significance.				

CONCLUSION

In the present study, different raw materials were used for the preparation of vermicompost such as cow dung, vegetable waste, corrugated cardboard and straw. The vermicompost so prepared was applied on tomato plant (*Lycopersicum esculentum*). Tomato plant was grown with the help of cocco peat as it helps in the fast seed germination as cocco peat absorbs more water and thus helps in rapid germination. After germination of the tomato seeds, it was put into the field and Vermicompost was added to it. The treated tomato plant was found to record healthier growth (with higher yield of fruits) as compared to control plant. Paired t-test analysis suggested significant difference between the growth of control and treatment (treated with vemicompost) samples. Findings suggest that basically vermicomposts are far better as compared to any other manure or normal soil as it gives better fertility and even it helps in the clean environment. So, we should use Vermicomposts for better yield.

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REFERENCE

Alidadi, H., F. Jaolie, A. Kamali, and S. Solymani (2007). Survey and choice of appropriate bed for preparing Vermicompost from animal wastes. 9th National Conference on Environmental Health, Esfahan University of Medical Science. Alikhani, H., B. Yakhchali, and L. Mohammadi. Comparing physio chemical properties of common compost and Vermi-compost. *Iranian Biology Journal* 6:925-934.

Amlinger, F., B. Gotz, P. Dreher, J. Geszti, and C. Weissteiner (2003). Nitrogen in biowaste and yard waste compost: Dynamics of mobilization and availability. *European Journal of Soil Biology* 39:107-116.

Atiyeh, R. M., J. Dominguez, S. Subler, and C. A. Edwards (2000). Change in biochemical properties of cow manure during processing by earthworms (*Eisenia anderi*, Bouche') and effects on seedling growth. *Pedobiologia* 44:709-724.

Atiyeh, R. M., S. Lee, C. A. Edwards, N. Q. Arancon, and J. D. Metzger (2002). The influences of humic acids derived from earthworm processed organic wastes on plant growth. *Bioresource Technology* 84:7-14.

Bayon, L. R. C., and F. Binet (2006). Earthworm changes the distribution and availability of phosphorous in organic substrates. *Soil Biology and Biochemistry* 38:235-246.

Elvira, C., L. Sampedro, E. Benitez, and R. Nogales (1998). Vermicomposting of sludges from paper mill and dairy industries with *Eisenia andrei*: A pilot scale study. *Bioresource Technology* 63:205-211.

Hartenstein, R., and F. Hartenstein (1981). Physicochemical changes effected in activated sludge by the earthworm *Eisenia fetida*. *Journal of Environmental Quality* 10:377-382.

Hoekstra, N. J., T. Bosker, and E. A. Lantinga (2002). Effects of cattle dung from farms with different feeding strategies on germination and initial root growth of cress (*Lepidium sativum* L.). *Agriculture, Ecosystems & Environment* 93:189- 196.

Khalfi, M., Z. Ghanavi, and S. Rezazade (2005). Comparison of chemical quality of compost and Vermicompost produced from sugar beet waste. 7th National Conference on Environmental Health, Shahrekurd University of Medical Science. Maboeta, M.

S., and L. Van Rensburg 2003. Vermi composting of industrially produced wood chips and sewage sludge utilizing *Eisenia fetida*. *Ecotoxicology and Environmental Safety* 56:265-270.

L. J. Chanu, S. Hazarika, B.U. Choudhury, Ramesh T., Balusamy A., P. Moirangthem, A. Yumnam and P. K. Sinha (2018). A Guide to vermicomposting-production process and socio economic aspects. Extension Bulletin No. 81 ICAR Research Complex for NEH Region, Umiam-793 103, Meghalaya.

Ndegwa, P. M., and S. A. Thompson (2000). Effects of C-to-N ratio on vermicomposting of biosolids. *Bioresource Technology* 75:7-12.

Ndegwa, P. M., and S. A. Thompson (2000). Effects of C-to-N ratio on vermicomposting of biosolids. *Bioresource Technology* 75:7-12.

Parvaresh, A., A. H. Movahedian, and L. Hamidian (2005). Survey of chemical quality and fertilizer values of Vermicompost prepared from municipal wastewater sludge in Esfahan. 7th National Conference on Environmental Health, Shahrekurd University of Medical Science and health services.

Tohidinejad, A., H. Madani, and M. Jenabi. (2011). Organic Fertilizer and Vermi-Compost Production (Useful Step in Constant Agriculture). 1st ed. ShahidBahounar University, Kerman, Iran, Publication Number 152.